PFRP

Pelagic Fisheries Research Program

Volume 3, Number 2

April 1998

LIBRARY
APR 2 0 RECD
National Marine Fisheries Service
2570 Dole Street
Honolulu, Hawaii

Economics and Fishery Management

The January 1998 PFRP newsletter featured legal considerations surrounding management of pelagic fish in the Pacific in the 1990s and presented information on the value of this resource. This month we continue in the economic realm by considering how it might be possible to determine the "best" harvesting strategy, or in other words, how to allocate catch among gear types.

PFRP

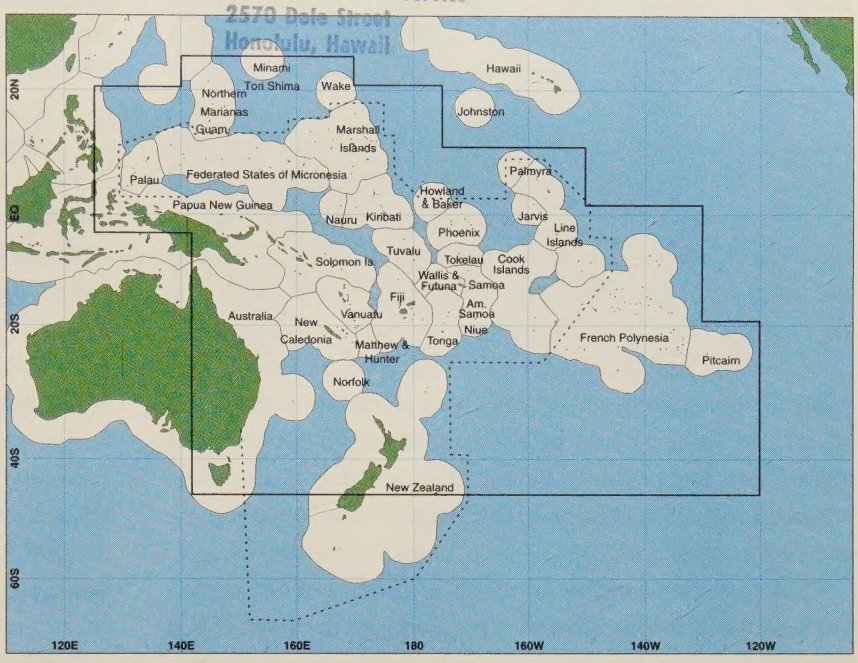

Figure 1. U.S. treaty area (dotted line) and SPC statistical area (heavy line)

How Many Purse Seiners Should Exploit the Western Pacific Tuna Fishery?

Below is a summary of the presentation given by Harry F. Campbell, University of Queensland, to the PFRP Principal Investigators Meeting's Workshop on Ocean-Scale Management of Pelagic Fisheries, held November 1997 in Honolulu.

The Western Pacific Tuna Fishery

A useful definition of the western Pacific tuna fishery is the area managed by the Forum Fisheries Agency (FFA) on behalf of its members and described in Figure 1 as the U.S. treaty area. Figure 1 also shows the South Pacific Commission (SPC) statistical area, which is similar to, but slightly more extensive than, the U.S. treaty area.

The western Pacific tuna fishery currently has a gross value of around US$1.6 billion of which purse-seine, long-line and pole-and-line fleets account for around 50%, 42% and 8% respectively. The purse-seine fleet expanded rapidly in the period 1980–95, with two important consequences. The total weight of catch from the fisheries rose by a factor of 2.4, and the share of purse-seine caught tuna in total catch rose from 13% to 79%. Over the same period, the longline catch fell by a third and the pole-and-line catch halved.

(continued on page 2)

CONTENTS

Economics and Fishery Management 1
How Many Purse Seiners Should Exploit the Western Pacific Tuna Fishery? 1
Access Fees, Economic Benefits in the W. Pacific U.S. Purse-Seine Tuna Fishery 5
Upcoming Events 5
Biological 'Threats' to Sustainable Tuna Fisheries 7

How many purse seiners (continued from page 1)

Currently around 150 distant water fishing nation (DWFN) purse seiners are licensed to operate in the region of the fishery managed by the FFA. The main DWFN countries are the United States (46), Taiwan (43), Japan (32) and Korea (29). The FFA member countries of Kiribati, Papua New Guinea, Solomon Islands and Vanuatu also operate a total of around 10 domestic tuna purse seiners.

The tuna fishery is an important resource for the developing nations of the Pacific islands whose exclusive economic zones (EEZ), or fishing zones, constitute a substantial portion of the fishery. The contribution of the fishery to those developing economies depends upon the net value of the fishery and the developing countries' share of net value in the form of access fees.

Given the high gross value of the fishery, it is possible that relatively small proportionate changes in resource allocation within the fishery could produce substantial benefits in net value terms. Depending upon the institutional structure, a significant proportion of these benefits could flow through to the developing countries.

The main focus of this paper is the number of purse seiners and the balance between the three gear types that will maximize the net benefits of the fishery. The discussion recognizes that changes in the catch composition of the western Pacific fishery may affect world market prices for tuna because of the substantial contribution of the region to world catches.

Stock Interactions Among Gear Types in the Western Pacific Tuna Fishery

In the western Pacific tuna fishery, four major tuna species are harvested by three major gear types. Currently, the driftnet and troll fisheries account for around 1% of catch by weight and can be ignored. The purse-seine and pole-and-line fisheries are both heavily dependent on the skipjack stock, and the purse-seine and longline fisheries both have a significant dependence on the yellowfin stock.

Since there is currently no concern about over-exploitation of the skipjack stock, competition between the purse-seine and pole-and-line fleets is of concern only in particular localities, such as the Solomon Islands, where both fleets exploit the same portion of the stock. From Table 1, it can be seen that around 25% of the purse-seine catch reported as yellowfin actually consists of juvenile bigeye tuna. There is currently concern about the status of the bigeye stocks with some evidence suggesting that catch levels are approaching, or possibly exceeding, maximum sustainable yield. The allocation of limited bigeye, and to a lesser degree yellowfin, stocks between the purse-seine and longline fleets is potentially a significant issue throughout the region.

Table 1. Average catch of major tuna species by gear type in the SPC statistical area, 1987–91

	Species (mt)			
Gear Type	Albacore	Bigeye	Skipjack	Yellowfin
Purse Seine	–	–	452,675	145,491
Longline	16,932	36,224	–	35,268
Pole and Line	–	–	117,981	3,847
Driftnet	7,278	–	–	–
Troll	5,955	–	–	–

Allocation of Yellowfin Tuna Between the Purse-Seine and Longline Fleets

Conceptually, the issue of allocating the yellowfin stock between the purse-seine and longline fleets is a simple matter: if the objective is maximizing the combined net value of the two fisheries, yellowfin should be allocated between the fleets so as to equalize the net benefit derived from the "marginal" tonne of fish taken by each gear type.

The concept of marginal net benefit can be illustrated by a simple example: juvenile yellowfin weigh 5 kg, are worth $0.74 per kg if caught by the purse-seine fleet; juveniles become adults after 18 months by which time they weigh 26.4 kg and are worth $2.58 per kg if caught by the longline fleet; natural mortality is 6.65% per month; and 25% of the adult yellowfin stock is caught by the longline fishery. Suppose that 100 juvenile yellowfin elude capture by the purse-seine fishery thereby contributing to the adult stock and the longline catch 18 months later. Assuming no changes in fishing costs or catches of other species, the purse-seine fleet loses $370 and the longline fleet gains $550, a real internal rate of return of around 30% per annum. At a 5% real rate of discount, the marginal net benefit of yellowfin to the longline fishery is $511, as compared with $370 in the purse-seine fishery.

Of course fishing effort and costs in the two fisheries may change with marginal changes in catch. However, the direction of the effect of these changes on the marginal net benefit calculations is not obvious. For example, suppose the purse-seine fleet maintains its effort level and substitutes skipjack for the 500 kg of yellowfin it gives up. Since the price differential between skipjack and juvenile yellowfin is around $0.04 per kg, the marginal cost of the reduction in yellowfin catch is a mere $20.

Analysis of purse-seine and longline vessel catch performance in Papua New Guinea's EEZ in the period 1980–86 provides some evidence that purse seiners can target juvenile yellowfin tuna by choosing fishing techniques, such as making school rather than log sets. If this is true, a policy such as a differential royalty on purse-seine yellowfin catch could be used to provide an incentive to reduce purse-seine yellowfin catch. In these circumstances, the monthly cost per vessel of the reduction in yellowfin catch, excluding the cost of the additional royalty (which is not a real cost but simply a transfer from vessel owners to PNG), is estimated to be only $15.91 per large U.S.-style purse seiner. Part of the reason for this negligible cost estimate is the small price differential between purse-seine caught yellowfin and skipjack tuna.

Alternatively, if purse seiners are unable to control the species composition of their catch, a reduction in purse-seine effort would be required to reduce juvenile yellowfin catch. This could be accomplished by a rise in the level of the access fee. A rise in the access fee would shift some purse-seine effort to less productive fishing grounds outside the EEZ. The monthly cost of this measure—excluding the cost of the higher access fee, which, as noted above, is simply a transfer to PNG—is estimated at $34.65 per vessel. Again this is a negligible amount because the portion of effort redirected to fishing grounds outside the EEZ suffers no great loss in productivity.

Based on these estimates, the calculation for the present value of the monthly net cost to the PNG purse-seine fishery—consistently of around 26 large purse seiners—of a 1% reduction in the purse-seine catch of yellowfin in the EEZ was $169,000 if the decline could be accomplished by targeting or $368,000 if a reduction in purse-seine effort was required.

Sharing Skipjack and Yellowfin Stocks Between the Purse-Seine and Pole-and-Line Fleets in the Solomon Islands EEZ

The purse-seine fleet is excluded from waters within the Solomon Islands Main Group Archipelago (MGA) as illustrated in Figure 2. The pole-and-line fleet can fish within or outside the MGA but is excluded from waters within 3 miles of shore, which are reserved for artisanal fishers. Both fleets catch skipjack and juvenile yellowfin tuna, and the activities of each fleet can potentially affect the catch of the other. The pole-and-line fleet consists of domestic, joint venture and

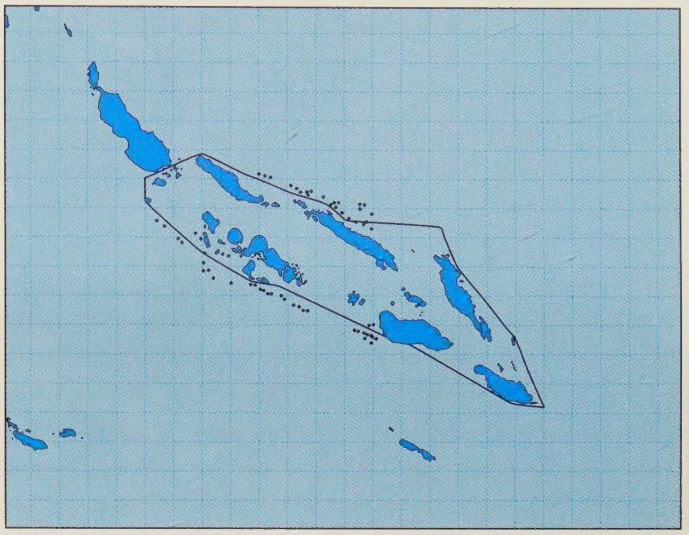

Figure 2. Solomon Islands Main Group Archipelago (MGA) baseline (heavy line) and the locations of FADs (dots)

Japanese vessels. The purse seiners, which are domestic vessels, tend to fish around fish aggregating devices (FADs), which are moored around the boundary of the MGA.

Using tuna tagging data collected by the SPC, an estimation model of skipjack and yellowfin tuna populations in the Solomon Islands EEZ was developed and then converted into a simulation model to predict purse-seine and pole-and-line catch as a function of the effort of each fleet and the number of FADs. The model suggests that, assuming tuna prices and unit costs of effort are held constant, the combined value of the Solomon Island purse-seine and pole-and-line fisheries would be maximized by increasing the level of purse-seine effort eightfold. This means increasing the purse-seine fleet from its current level, which is the equivalent of one effective full-time vessel, to eight vessels.

The model also suggests that FADs are a very effective investment. They attract and retain stocks of fish and make it easier for vessels to locate concentrations of tuna. When the model is run at the current levels of effort but without FADs, the annual value of the combined fisheries falls dramatically—by a factor of 10. When the model is run with an additional FAD in each of the 20 half-degree cells comprising the fishing zone, the combined profit of the fisheries rises by $1.5 million per annum, which is around 10%. Since an extra 20 FADs would cost around $64,000 per annum to maintain, increasing the number of FADs seems to be a good investment opportunity.

continued on page 4

A Multi-Species, Multi-Gear Regional Bioeconomic Model

To determine the optimal level of exploitation and the balance among the three major gear types, a regional bioeconomic model is required. A complete model would account for the movements of fish in response to environmental variation, the movements of vessels in response to fish movements, fish growth and population age structure, recruitment, gear selectivity, catchability and price and cost structures. A regional population simulation has been developed that has some of these characteristics and uses one species (skipjack) and two gear types (purse seine and pole-and-line). The model was used to predict CPUE for each fleet in each month, given the predicted distribution of the skipjack stock and the observed historical distribution of the two fleets.

That model is a precursor to a forthcoming model that will contain four species (albacore, bigeye, skipjack and yellowfin) and three gear types (longline, pole-and-line and purse seine).

Further research using the regional bioeconomic model may support a case, on economic grounds, for reducing purse-seine catches because of their effect on the value of the longline fishery.

Conclusion

It is well recognized that an unregulated fishing industry tends to be associated with overfishing from an economic and perhaps a biological point of view. In the absence of management there are no forces driving the western Pacific tuna purse-seine industry towards an equilibrium that is consistent with maximizing the value of the region's tuna fisheries as a whole. Three considerations that management needs to take into account are the sustainability of purse-seine catches relative to the size of the fish stocks; the impact of the purse-seine fishery on the value of other tuna fisheries in the region; and the effect of the region's catches on world tuna prices. Addressing the first issue, there seems to be no ground for concern about the sustainability of skipjack catches, and while there are emerging concerns about the status of bigeye stocks, the sustainability of the purse-seine fishery does not appear to be an issue at the present time.

Since skipjack is the main target species of purse seiners it might be expected that the most direct impact of the purse-seine fishery on the other gear types would be the impact on the pole-and-line fishery, which also exploits the skipjack stocks. However, given that the skipjack stocks appear to be relatively lightly exploited from a biological point of view, such an impact, if it exists, is likely to occur at a local level only.

On the other hand, there is some evidence that a reduction in the western Pacific purse-seine yellowfin catch would increase the value of the region's longline fishery by more than the fall in value of the purse-seine fishery, but this issue needs further investigation. In addition, emerging concerns about the status of bigeye stocks need to be addressed in the context of the appropriate balance between purse seining and longlining.

The issue of the appropriate balance among the three gear types poses some important challenges for management. Firstly, more evidence on the effects of marginal changes in fleet sizes on prices, harvests and costs needs to be obtained and assessed. Secondly, if there is a case for change, the Pacific island nations need to agree on the appropriate management measures. Under the current system of sharing the returns from the regions' fisheries among the Pacific island nations, any change in fleet composition would involve a change in the distribution of rents as well as a change in their level. This may compound the difficulty of reaching a consensus on policy direction. Thirdly, management needs to be able to enforce whatever measures are decided upon. A management regime that increases the value of the fisheries also increases the incentive for illegal fishing, thereby making enforcement a greater challenge.

PFRP

For a copy of Campbell's complete presentation, contact

PFRP Administrative Assistant Dodie Lau
TEL (808) 956-7895 FAX (808) 956-4104
E-MAIL dlau@soest.hawaii.edu

or contact

The Joint Institute of Marine and Atmospheric Research
University of Hawai'i at Mānoa
1000 Pope Road, MSB 313
Honolulu, HI 96822
TEL (808) 956-8083 FAX (808) 956-4104

Access Fees and Economic Benefits in the Western Pacific U.S. Purse-Seine Tuna Fishery

The following excerpt is from a study by Samuel F. Herrick Jr., Byron Rader and Dale Squires of the National Marine Fisheries Service, Southwest Fisheries Science Center, La Jolla, California, which appears in Marine Policy, *Vol. 21, No. 1.*

The region of the South Pacific Forum Fisheries Agency (FFA) is a vast area of the western tropical Pacific bounded approximately by Australia, New Zealand, Hawai'i and the Philippines (see page 1, Figure 1). The island states of this region have developing economies that are extremely dependent on the few indigenous resources they share, one of the most valuable being tuna.

U.S. tropical tuna purse-seine vessels began exploratory fishing in these waters in 1976 financed by federal grants awarded under the Saltonstall-Kennedy Act. The United States' presence in the area expanded rapidly during the early 1980s, from less than 10 vessels in 1980 to more than 60 in 1984. The increase was due to abundant tuna resources in the area and to the adverse effects of El Niño on tuna in the eastern tropical Pacific and continuing problems of access to traditional fishing grounds in that region.

Development of the tuna fishery brought unprecedented prospects for economic growth in the Pacific island states. Pacific island governments sought ways to develop their own tuna fisheries or benefit from fishing by others.

(continued on page 6)

Pelagic Fisheries Research Program Newsletter
Volume 3, Number 2 **April 1998**

Editor John Sibert
Writers Sylvia Spalding and John Sibert
Layout May Izumi
Printing Fisher Printing/Pioneer Printers, Honolulu HI 96817

For more information

Pelagic Fisheries Research Program
Joint Institute for Marine and Atmospheric Research
University of Hawai'i at Mānoa
1000 Pope Road, MSB 313
Honolulu, HI 96822

TEL (808) 956-4109 FAX (808) 956-4104

E-MAIL jsibert@soest.hawaii.edu
WWW http://www.soest.hawaii.edu/PFRP/

Upcoming Events

May 11–15
ICCAT Workshop on Abundance Indices from Tropical Tuna Surface Fisheries, Miami, Fla.; contact: Pamela Mace, NMFS, Northeast Center, 166 Water St., Woods Hole, MA 02543, USA; tel. 1-508-495-2357; fax 1-508-495-2393; e-mail pamela.mace@noaa.gov

May 18–21
Forty-Ninth Annual Tuna Conference, Lake Arrowhead, Calif.; contact: Christofer Boggs, NMFS Honolulu Laboratory, 2570 Dole St., Honolulu, HI 96822-2396, USA; tel. 1-808-943 1222; fax 1-808-943-1290; e-mail cbogg@honlab.nmfs.hawaii.edu

May 24–29
1998 Ocean Circulation and Climate—The 1998 WOCE Conference, Halifax, Nova Scotia, Canada; contact: John Gould, WOCE IPO, Southampton Oceanography Centre Room 256/18, Empress Dock, Southampton, SO14 3ZH, UK; tel. 44-1703-596789; fax 44-1703-596204; e-mail woceipo@soc.soton.ac.uk; http://www.soc.soton.ac.uk/OTHERS/woceipo/wconf

May 28–29
Workshop on Precautionary Limit Reference Points for Highly Migratory Fish Stocks in the Western and Central Pacific Ocean, Honolulu, Hawaii; contact: A. D. Lewis, Offshore Fisheries Programme, South Pacific Commission, Noumea, New Caledonia; tel. 687-26-20-00; fax 687-26-38-18; e-mail tonyl@spc.org.nc

June 1–6
Standing Committee on Tuna and Billfish, Honolulu, Hawaii; contact: A. D. Lewis, Offshore Fisheries Programme, South Pacific Commission, Noumea, New Caledonia; tel. 687-26-20-00; fax 687-26-38-18; e-mail tonyl@spc.org.nc

June 15–19
PACON 98 Conference on the 8th Pacific Congress on Marine Science and Technology, "Toward the 21st Century—The Pacific Era," Seoul, Korea; contact: PACON International, P.O. Box 11568, Honolulu, HI 96828-0568, USA; tel. 1-808-956-6163, fax 1-808-956-2580; e-mail pacon@wiliki.eng.hawaii.edu

June 20–25
Second International Symposium on Fish Otolith Research and Application, Bergen, Norway; contact: Oto-98, Institute of Marine Research, Flodevigen Marine Research Station, N-4817 His, Norway; fax 47-37-05-9001; e-mail symp98@flode.imr.no; http://www.imr.no/sear/oto98.html

July 8–11
Ninth International Conference of the International Institute of Fisheries Economics and Trade, Tromso, Norway; contact: IIFET Secretariat, Oregon State University, Dept. of Ag. & Resource Econ., Corvallis, OR 97331-3601, USA; tel. 1-541-737-1416; e-mail ann.l.shriver@orst.edu

Access fees, economic benefits (continued from page 5)

The Pacific island states gained significantly from the 1982 United Nations Convention on the Law of the Sea (UNCLOS), which approved the creation of 200–nautical-mile exclusive economic zones (EEZ) and sovereignty of coastal states over the living resources therein.

In accordance with UNCLOS, Pacific island states claimed jurisdiction over tuna and other highly migratory species within their EEZs. This move was at odds with U.S. policy, which considered tuna "highly migratory species" and, consequently, not subject to exclusive jurisdiction. U.S. purse seiners began to operate within the EEZs of Pacific island states, which was illegal by Pacific island states' law although not by U.S. law. This precipitated a number of highly publicized vessel seizures and soured relations between the United States and island states. A treaty was therefore seen as necessary by both the U.S. government and the Pacific island states.

In September 1984 multilateral negotiations commenced for a tuna agreement between the United States and the south Pacific states of the FFA. The multilateral approach was preferred by the United States because it was consistent with its position that highly migratory species are appropriately managed through international arrangements between nations that harvest tuna or are adjacent to their migration routes. The FFA was considered a suitable negotiating partner because its members had EEZs with tuna fishing grounds of most interest to the U.S. fleet.

The negotiations concluded in 1987 with an agreement that is popularly known as the South Pacific Tuna Treaty (SPTT). It afforded access for up to 50 U.S. flag vessels in exchange for approximately US$67 million over the five-year life of the agreement. The terms included an annual minimum fee paid by fishers that averaged $52,000 per vessel, an annual $10 million development assistance payment from the U.S. government and a $250,000 annual technical assistance contribution from the U.S. tuna industry.

The SPTT was extended in 1991. The dolphin-safe purchasing policy established by U.S. processors in 1990, which shifted most U.S. tuna purse-seining operations from the eastern to the western Pacific, was a significant factor in the renegotiations. The renegotiated SPTT permits up to 55 U.S. flag vessels to fish for a period of 10 years. Under the new agreement, the industry pays a $4 million fee annually to cover licenses, technical assistance and an observer program for the first five years. This is equivalent to an average base vessel payment of $72,700 per year. The industry fee structure may be revised at the beginning of the sixth year. The annual assistance payment for economic development from the U.S. government under the new agreement is $14 million.

Because resource rent is difficult to estimate and depends on the level of harvest, associated costs and ex-vessel prices, actual payments under the established SPTT fee structure may differ substantially from the resource rents generated by the fishery.

To evaluate the distribution, between U.S. harvesters and FFA nations, of potential short-run profit (also called quasi-rent or producer surplus) from the tropical tuna caught by U.S. harvesters under the SPTT, the following methods were used: First, linear programming was used to estimate the maximum short-run profit attainable from observed, and postulated, landings of yellowfin and skipjack tuna harvested by the U.S. fleet in SPTT waters. Second, an optimum access fee was calculated based on the estimated short-run profit generated by U.S. harvesters. Third, the net economic benefit that would accrue to the U.S. fleet under the optimum fee was estimated. And, fourth, an assessment was made on how all these values would have changed over the years 1989 through 1992.

Several key points emerge from the analysis.

- vessels larger than 1,200 tons in carrying capacity realize higher short-run profits;
- more trips increase short-run profits and net economic benefits to the U.S. fleet;
- skipjack availability and harvest levels are more important to short-run profits and U.S. net economic benefits than yellowfin availability and harvest levels;
- a potential exists for sizable short-run profits and net economic benefits after payment of an access fee;
- net economic benefits and maximum short-run profits differ.

The importance of skipjack availability and harvest levels suggests that, in the event of country or species specific quotas, U.S. negotiators should strive to ensure sufficient levels of skipjack. There might even be some latitude for a trade-off between skipjack and yellowfin quotas, where U.S. negotiators concede yellowfin to gain some skipjack.

PFRP

Biological 'Threats' to Sustainable Tuna Fisheries

In this article John Sibert, director of the Pelagic Fisheries Research Program, offers business persons and tuna fisheries development personnel some sound advice on how to avoid "threats" to "sustainability" in the Pacific tuna fisheries.

A "sustainable" fishery is a fishery that makes money over the long haul. The problem of creating a sustainable tuna fishing industry, therefore, is essentially a business problem. Solving the problem successfully requires explicit consideration of natural constraints imposed by the dynamics of fisheries, the oceanography of the Pacific and the biology of tunas. Business plans should take into consideration these sources of variability, which could be viewed as "threats," in addition to the usual economic projections.

Fishing Kills Fish

Anyone planning to invest in the harvesting sector should not use estimates from the initial phase of a developing fishery when forecasting future profits. A more conservative rule of thumb would be to use some fraction, one-half or less, of the initial estimates to project revenues at full exploitation.

The purpose of commercial fishing is to remove fish from a population and convert them into money. In a typical fishery development scenario, the size of the fish population declines as the fishery develops and will continue to decline until growth of the fishery is halted. When the fishery is prevented from further growth, the size of the fish population will fluctuate around a new level that may be substantially lower than before the fishery began. Indeed, the classic theory of fishery dynamics tells us that the size of the exploited population is exactly half of the unexploited population.

The profitability of harvesting depends on being able to catch a large number of fish with a small amount of fishing effort. Catch per unit of effort (CPUE) is a measure of the efficiency of the fishing process. The reduction of fish abundance caused by fishing will inevitably lead to a decline in CPUE. The profitability of the fishery will thus also decline as the fishery develops. In other words, CPUE will inevitably fall, and fishing will never be as good as it was in the "old days."

The Ocean Is Variable

The El Niño that began in 1997 should remind us that the ocean that we think we know today is not the ocean that we will experience tomorrow. Bad years, and even bad decades, are certain to occur, and business plans should include explicit provisions for periods with low CPUE.

Annual variability of the ocean has two profound effects on pelagic fisheries. First, it affects local abundance, distribution and vulnerability of fish to fishing gear. As an example, swordfish catches by Honolulu-based longline fleet are strongly dependent on the strength and position of a major oceanographic front in the north Pacific, the subtropical convergence zone. Second, oceanographic conditions may profoundly affect population dynamics by mediating spawning and larval survival. For example, the reproductive success of the south Pacific albacore population, as measured by the abundance of juvenile fish in the fishery, is severely inhibited during major El Niño periods. Conversely, the reproductive success of yellowfin tuna in the eastern tropical Pacific appears to be enhanced during El Niño periods.

The productivity of the ocean also varies on longer time scales. There is a growing body of evidence that there are periods of low and high productivity that persist for a decade or more. These long-term cycles are not restricted to higher latitudes or to the northern hemisphere, but appear to occur throughout the ocean. The idea of sustainability is difficult to reconcile with such variability. We should not expect any fishery to have constant yield from one decade to the next.

Tunas Are Highly Migratory

In planning investment in fisheries development, it is prudent to be well informed about developments in the Pacific as a whole. Individuals contemplating long-term investment in tuna fisheries in the Pacific should be aware that the regulatory environment may change drastically in the next few years. Countries involved in tuna fisheries development should be actively engaged in the current international negotiations.

The geographic ranges occupied by tuna species in the Pacific Ocean are truly impressive. The most important commercial species—skipjack, yellowfin, bigeye and albacore—generally occupy the Pacific from one shore to the other, although their population density is by no means uniform throughout their range. The mobility and wide distribution of both tunas and tuna fleets increase the possibility that disturbances, natural or man-made, in one part of a tuna's range may influence conditions in another. For

continued on page 8

Biological 'threats' (continued from page 7)

instance, high catches in one area may depress the CPUE in another area.

But more important than the biological implications of tunas being "highly migratory" are the political consequences. The United Nations Convention on the Law of the Sea and the Implementing Agreement on Straddling Stocks and Highly Migratory Stocks place the responsibility for the management of highly migratory species on appropriately constituted international organizations. These organizations will ultimately regulate fisheries on the high seas, that is, outside of 200-mile exclusive economic zones. Currently, there is no international body with responsibility for management of highly migratory species in the Pacific. Events are proceeding rapidly, however, and Pacific island states and distant-water fishing nations are engaged in active dialogue and negotiation that will result in an international tuna management arrangement in 2000. Specific consequences will not be known until the new organization is established, but they will influence the conduct of fisheries both on the high seas and within exclusive economic zones.

PFRP

PFRP Pelagic Fisheries Research Program

Pelagic Fisheries Research Program
Joint Institute for Marine and Atmospheric Research
University of Hawai'i at Mānoa
1000 Pope Road, MSB 313
Honolulu, HI 96822